

INTI INTERNATIONAL UNIVERSITY
 FOUNDATION IN SCIENCE (CFSI)
 CHM1203: CHEMISTRY 1
 FINAL EXAMINATION: AUGUST 2015 SESSION

Instructions: This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

- (a) Classify each as physical change or chemical change.
- (i) Bleach removes a stain. (1 mark)
- (ii) An enzyme breaks down the lactose in milk. (1 mark)
- (iii) Peppercorns are ground into flakes. (1 mark)
- (b) Element Na, Al, P, Cl and Ar are in period 3. Select the element that
- (i) has the highest melting point (1 mark)
- (ii) forms diatomic molecular gas (1 mark)
- (c) Answer the following for the reaction
- $$\text{Pb}(\text{NO}_3)_2(aq) + 2\text{KCl}(aq) \rightarrow \text{PbCl}_2(s) + 2\text{KNO}_3(aq)$$
- (i) How many grams of PbCl_2 that can be formed from 50.0 ml of 1.50 M KCl solution? (3 marks)
- (ii) How many milliliters of 2.00 M $\text{Pb}(\text{NO}_3)_2$ solution will react with 50.0 ml of 1.50 M KCl solution? (3 marks)
- (d) Carbon dioxide is a chemical compound with the formula, CO_2 .
- (i) Name the type of bonding in the CO_2 (1 mark)
- (ii) Determine whether it is a polar or non-polar molecule. (1 mark)
- (iii) Draw the Lewis structure of the compound. (2 marks)
- (e) State the period, group for each of the following.
- A: $1s^2 2s^2 2p^6 3s^2 3p^6$
- B: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5$
- C: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
- D: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$ (4 marks)
- (f) Find the $[\text{H}^+]$ and the pH for the following solutions:
- (i) 0.76 M KOH (2 marks)

(ii) $3.4 \times 10^{-4} \text{ M H}_2\text{SO}_4$

(2 marks)

(g) What is the molarity (M) of 60.0 g of NaOH in 0.250 L of solution?

(2 marks)

(TOTAL: 25 MARKS)

Question 2

- (a) Balance each of the following equations and identify the type of reaction :
- (i) $\text{NaOH(aq)} + \text{FeCl}_3\text{(s)} \rightarrow \text{Fe(OH)}_3\text{(s)} + \text{NaCl(aq)}$ (2 marks)
- (ii) $\text{C}_4\text{H}_{10}\text{(g)} + \text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)} + \text{H}_2\text{O(l)}$ (2 marks)
- (b) Indicate whether the elements by the given pairs of electron configurations have similar chemical properties.
- (i) $1s^22s^22p^63s^23p^4$ and $1s^22s^22p^63s^23p^64s^23d^{10}4p^4$ (2 mark)
- (ii) $1s^22s^1$ and $1s^22s^22p^63s^23p^64s^1$ (2 mark)
- (c) Nitrogen dioxide and water react to produce nitric acid, HNO_3 , and nitrogen monoxide:
- $$3\text{NO}_2\text{(g)} + \text{H}_2\text{O(l)} \rightarrow 2\text{HNO}_3\text{(aq)} + \text{NO(g)}$$
- (i) How many grams of H_2O are required to react with 28.0 g of NO_2 ? (3 marks)
- (ii) How many grams of NO are obtained from 15.8 g of NO_2 ? (3 marks)
- (iii) How many grams of HNO_3 are produced from 8.25 g of NO_2 ? (3 marks)
- (d) A complete combustion of a hydrocarbon forms 1.10 g of CO_2 and 0.45 g of H_2O . The molar mass of a hydrocarbon, **X** is 84.00 g mol^{-1} .
- (i) Define empirical and molecular formula (2 marks)
- (iii) Determine the empirical and molecular formula of the hydrocarbon **X**. (2 marks)
- (e) For each of the following solutions, how many milliliters of water should be added to yield a solution that has a concentration of 0.100 M?
- (i) 50.0 mL of 1.00 M HCl (2 marks)
- (ii) 1.45 L of 3.00 M NaCl (2 marks)
- (TOTAL: 25 MARKS)**

Question 3

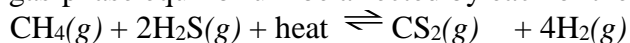
- (a) Write the electronic configurations of :
- (i) P^{3-} (2 marks)
- (ii) Mn^{2+} (2 marks)
- (b) (i) Define the term buffer solution. (2 marks)
- (ii) Give an example of buffer solution that has a pH less than 7. (1 mark)
- (c) An oxidation-reduction (redox) reaction is a type of chemical reaction that involves a transfer of electron between two species.
- (i) Write a balanced ionic equation for redox reaction below.

$$MnO_4^- + S^{2-} \rightarrow Mn^{2+} + S \text{ (acidic solution)}$$
 (6 marks)
- (ii) Determine the reducing agent and the oxidizing agent. (2 marks)
- (d) Indicate the type(s) of attractive forces (dipole-dipole forces, hydrogen bonds or London forces) that occurs between the particles :
- (i) $CHCl_3 - CHCl_3$ (2 marks)
- (ii) $H_2O - H_2O$ (2 marks)
- (e) State Boyle's law and Charles's law. (2 marks)
- (i) A sample of gas occupies 100.0 mL at 25°C. What volume would the gas occupy at 32°C if the pressure remains constant? (2 marks)
- (f) Predict which compound in each of the following pairs that has higher melting and boiling points.
- (i) CO and CH₄ (1 mark)
- (ii) NH₃ and N₂ (1 mark)

(TOTAL : 25 MARKS)

Question 4

- (a) How will the gas-phase equilibrium be affected by each of the following?



- (i) The removal of $\text{H}_2(g)$ (1 mark)
- (ii) The addition of $\text{CS}_2(g)$ (1 mark)
- (iii) An increase in temperature (1 mark)
- (iv) A decrease in pressure (1 mark)
- (b) Write a balanced chemical equation for the reaction of $\text{HCl}(\text{aq})$ with each of the following chemical;
- (i) $\text{K}_2\text{CO}_3(\text{s})$ (2 marks)
- (ii) $\text{Mg}(\text{OH})_2(\text{s})$ (2 marks)
- (c) When heated, calcium carbonate decomposes to give calcium oxide and carbon dioxide gas:
- $$\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$$
- If 2.00 moles of CaCO_3 react, how many liters of CO_2 gas are produced at STP? (2 marks)
- (d) Collision theory summarizes the condition required for a chemical reaction to take place. Explain the statements of the collision theory. (6 marks)
- (e) A reaction between 7.0 g of copper(II) oxide and 50 mL of 0.20 M nitric acid produces copper(II) nitrate and water.
- (i) Write a balanced equation for the reaction above. (2 marks)
- (ii) Determine the limiting reactant. (3 marks)
- (f) What is the oxidation number for the **underlined** element in each of the following? Determine whether it is an oxidation or reduction process?
- (i) **Cr** $_2\text{O}_7^{2-}(\text{aq}) \rightarrow \text{Cr}^{3+}(\text{aq})$ (2 mark)
- (ii) **S** $_2\text{O}_3^{2-}(\text{aq}) \rightarrow \text{S}_4\text{O}_6^{2-}(\text{aq})$ (2 mark)

(TOTAL : 25 MARKS)

Question 5

- (a) During heavy exercise and workouts, lactic acid, $C_3H_6O_3$, accumulates in the muscles, where it can cause pain and soreness.
- (i) What is the molar mass of lactic acid? (2 marks)
- (ii) How many molecules are in 0.500 mole of lactic acid? (2 marks)
- (b) Use **dotted lines** to show hydrogen bonding in the following cases :
- (i) Between propanoic acid molecules (C_2H_5COOH). (3 marks)
- (ii) Between propanoic acid and water molecules. (C_2H_5COOH and H_2O). (3 marks)
- (c) Consider the following equilibrium.
- $$CO(g) + H_2O(g) + \text{heat} \rightleftharpoons CO_2(g) + H_2(g)$$
- For each of the following adjustments of conditions, indicate the effect (shifts left, shifts right or no effect) on the position of the equilibrium.
- (i) Refrigerating the equilibrium mixture (1 mark)
- (ii) Adding a catalyst (1 mark)
- (iii) Increasing the size of the reaction container (1 mark)
- (d) Determine the molarity of NaOH solution when 23.76 ml of 1.00 M HCl neutralizes 25.0 ml of the NaOH solution. (3 marks)
- (e) Ammonium dichromate decomposes according to the following reaction.
- $$(NH_4)_2Cr_2O_7 \rightarrow N_2 + H_2O + Cr_2O_3$$
- (i) Write a balanced equation. (2 marks)
- (ii) How many grams of each of the products can be formed from the decomposition of 75.0 g ammonium dichromate? (3 marks)
- (f) By using the solubility rules, predict whether each of the following ionic compounds is soluble (S) or insoluble (I) in water:
- (i) $PbCl_2$ (2 marks)
- (ii) Ag_2SO_4 (2 marks)
- (TOTAL : 25 MARKS)**

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